clouds, dew, and frost, prediction of frost, and the protection from frost. The cause, formation, and forward movement of the cyclonic and anticyclonic areas, and of local thunder and hail storms, and of the more severe tornadoes, as they appear on the daily weather maps, will be carefully studied in this part of the course. Attention will then be turned to the causes and distribution of rainfall. The relations between rainfall and agriculture, rainfall and forests, migration of rain belts, and the effect of clouds and rainfall on the general circulation of the atmosphere will be touched upon. The study of the weather and climate, particularly of the United States, will close the course.

Dr. Isaac M. Cline, M. A., M. D., Ph. D., Local Forecast Official and Section Director in the Weather Bureau, is lecturer on climatology in the University of Texas. The course in medical climatology was delivered by him during the winter of 1898–99 weekly to the fourth year students.

The course embraced briefly a description of instruments and methods used in determining climatic conditions and changes; the origin of the atmosphere, its evolution, composition, and offices together with its extent and spherical arrangement; the control of atmospheric temperatures, radiation, insolation, absorption, transmission, conduction and reflection, with particular reference to the manner in which local conditions influence these in making differences in climate; the distribution of temperatures over land and water; the pressure and general wind movements and the ways in which they influence general and local climate; the moisture of the atmosphere, absolute and relative humidity, and sensible temperature of the atmosphere; clouds and sunshine and their distribution; the causes of distribution of precipitation; weather and the control of weather changes, with generalizations as to weather forecasting. Then was taken up the manner in which weather changes and different conditions of climate influence the physiological functions of different organs of the body; the divisions of climates based upon these effects into "low, damp, warm climate," low, damp, cold climate," "high, dry, climate," and intermediate grades; the mineral springs; topographic features and distribution of climate in the United States; the relation of climate to pathology and its influence in the distribution of the more important classes of diseases. Charts and diagrams were used where practicable to illustrate the more important features of the lectures.

Dr. O. L. Fassig, Ph. D., (Johns Hopkins University, 1899), has been instructor in climatology in the department of geology since 1896. His course during the year 1897–98 was twice weekly for two months:

In this course of lectures the topics chiefly considered were: Heat and its distribution over the earth's surface; rainfall and evaporation, their distribution and effects; winds and storms; weather sequences as illustrated by the daily weather charts of the United States Weather Bureau; extent to which topography influences the distribution of the climatic elements; variability of climates; organization and methods in statistical meteorology.

There was also two weeks of field work by the students in a meteorological camp occupied by them in the spring of 1898 in western Maryland.

During the year 1898–99 the following lectures were given, being intended especially for students in geology, medicine, and physics: I. The scope and aim of climatology; the earth's atmosphere; climatic factors. II. Solar radiation. III. The distribution of temperature at the earth's surface. IV. The distribution of atmospheric pressure and the resulting movements of the atmosphere. V. Storms. VI. The moisture of the atmosphere; its visible forms as cloud, rain, snow, dew, fog, etc. VII. Rainfall and its distribution at the earth's surface. VIII. Climates with special reference to the climate of the United States. IX. The daily weather chart. X. Forecasting the weather. XI. The movements of ocean waters and their influence upon climates. XII. Variations in climate, periodic and secular.

During the coming college year, 1899–1900, Dr. Fassig's course will embrace twenty or more lectures on the various aspects of climatology.

The fact that Harvard University accepts an examination in elementary meteorology with original note books of observations and laboratory work as one of the items for admission to Harvard College and the Lawrence Scientific School and as preparatory to higher work in meteorology within the University itself, must greatly stimulate high schools and academies to introduce this subject in their own course of study. An admirable pamphlet of sixteen pages has been published by that University, giving in detail the elementary course of instruction that should be pursued at such academies and further information may be obtained from Mr. R. deC. Ward, Cambridge, Mass.

At some future time the Editor hopes to summarize the instruction given in meteorology by those who are *not* officials of the Weather Bureau.

THE WEATHER AND THE DAIRY.

In the August report of the Virginia Section Mr. E. A. Evans collects together what little is known with reference to the relation of cold weather to the quantity and quality of the milk given by cows. It appears that in general there is a decided diminution in the cream as soon as the weather turns cold, thus justifying the practice of dairymen in keeping the barns artificially heated during cold weather. An interesting case is quoted by Mr. Evans from his own experience in northern Minnesota, in which, although the barn was not artificially heated, yet the cow gave an abundance of rich milk because the ration that was fed to her every evening was hot instead of cold; otherwise the quality and quantity were the same as those given to other cattle.

BALL LIGHTNING.

In the August report of the Utah Section Mr. L. H. Murdoch publishes an account of lightning phenomena that occurred in Salt Lake City in the yard of Senator J. L. Rawlins in Salt Lake City on August 4. This ball is said to have first appeared to be about a foot in diameter, of a ruby red color, entering an open window on the north side of the house. It passed across the hall into the sitting room and out of an open south window, bending and twisting the shrubbery in front of the latter. It then passed southward, tearing up some sod in the yard, and struck a poplar tree about 50 feet distant. The south side of the tree was torn and shattered.

In the usual typical cases of ball lightning very little destruction is reported. The whole phenomenon seems to be confined to the atmosphere and the luminous ball rolls along very slowly. In the present case the tearing up of the sod in the yard and the injury to the poplar tree suggests that after all this may have been only an ordinary discharge of lightning. The doubt would be entirely removed if the observer had stated how many seconds were occupied by the ball in passing from the north side of the house through the latter to the poplar tree.

In the August report of the Maryland and Delaware Section Mr. F. J. Walz publishes a case of ball lightning described by Dr. Stokes, but there is no clear evidence that this differed essentially from an ordinary discharge of lightning.

In former times English writers frequently spoke of a bolt of lightning, or a lightning bolt. This is a figurative expression rather than a descriptive one, and apparently refers to the suddenness of the occurrence. Possibly our observers

are liable to inadvertently speak of a ball of lightning when they intend to speak of a bolt.

In his August report, Mr. J. Warren Smith gives a diagram illustrating a new feature in lightning flashes, as described by Mr. E. W. Dimock, Voluntary Observer at Dupont, Ohio:

When the flash occurred it divided at an altitude of about 20° above the horizon and from the junction of the two branches a bright red ball descended perpendicularly and slowly until lost to sight. A sharp clap of thunder followed in about four seconds.

FILLET OR RIBBON LIGHTNING.

Mr. J. Nelson Trask, under date of September 22 states that at New Salem, Franklin County, Mass., on September 2, 1898, he recorded a ribbon flash, which he calls a fillet flash, different from anything he had seen before. From among the many details given by him, relative to the thunderstorm of that afternoon we quote the following:

I never saw so many flashes shooting horizontally, slanting, or crooked, branched and filleted. The fillet was very curious, it fell sloping with short bright and dark bands alternating, like those of a stepping waterfall.

The zig-zag band sketched by Mr. Trask with its alternate bright and dark spaces would perhaps, if it had been photographed from nature, have appeared as simply one variety of twisted ribbons that are so well known. But while hazarding this conjecture, the Editor must acknowledge that if the zig-zag fillet really preserved its full width throughout and was built up of alternate bright and dark portions, as drawn by Mr. Trask, then we certainly have an entirely new type of lightning flash.

DISTANT LIGHTNING.

On Monday, September 4, a flash of lightning that seemed to have occurred over Salt Lake City, Utah, appears also to have been observed by Mr. James Clove, editor of the Provost Enquirer, who was at that time traveling in Piute County, 200 miles south of Salt Lake. Mr. Clove observed at 4:20 p. m. a most vivid flash of lightning among the dark clouds of the north. It seemed near by, but no thunder was heard. Piute is about 2,000 feet higher than Salt Lake City, and Mr. Clove asks whether it could possibly be that the flash witnessed by him was that which did so much damage in the latter city.

As Mr. Clove saw his lightning among the lower dark clouds of the north and as such clouds can not be seen many miles away, it is evident that this flash is not likely to have been identical with that over Salt Lake City. Even if the dark clouds that he saw comparatively near him had been absent, leaving only ordinary clear air between his station and Salt Lake City, still it is not likely that a flash over the latter city would have been visible as a vivid flash at Piute, since the brightest sunshine reflected from a mirror and observed with a large telescope can not be seen through 200 miles of dry dusty air. Flashes of sunlight are often sent as signals from one mountain top to another at a very great distance, but in such cases both observers must be on mountains so that the flash need not pass through the dusty air of the lowlands.

On the other hand, the lightning of an ordinary thunderstorm frequently illuminates the hazy and dusty air up to a height of several thousand feet and to a horizontal distance of many miles, so that an observer 200 miles away may detect the presence of a distant thunderstorm by the flashes known as heat lightning that are seen in the distant clouds above the horizon. But these flashes do not correspond to to the vivid flash among the clouds described by Mr. Clove.

If several observers 50 or 100 miles apart should keep a complete list of the exact bearing of every appearance of distant heat lightning and should draw the proper lines upon a map the intersections of these lines would, undoubtedly, give the exact locations of the storms themselves and thus contribute to complete our history of local thunderstorms.

Owing to the curvature of the earth and the refraction of the rays of light passing through the atmosphere, a point that to an observer at sea level appears to be exactly in the horizon, viz, 90° from the zenith, can not be on the earth's surface, but must be some distance above it. If the point is twenty miles away, it will be about 228 feet above sea level and if it is 200 miles away, it will be nearly 23,000 feet above sea-level. Its elevation in order to appear in the horizontal plane of the distant observer, is calculated by the rule that the elevation in feet is 0.571714 times the square of the distance in miles.

THE STORMS OF AUGUST 2.

A series of local destructive storms occurred on Wednesday, August 2, in several States from New York to Virginia. So far as the State of Maryland is concerned, Mr. F. J. Walz made an exhaustive collection of data and has published an excellent summary in the August report of the Maryland and Delaware sections. Although generally called a thunderstorm, yet many of the conditions peculiar to tornadoes were observed. Some observers noted a funnel shaped cloud formation, others heard the loud and continuous roaring sound, while at many points in Montgomery, Calvert, and St. Mary's counties the winds were tornadic in their nature. Mr. Walz's chart of greatest destruction by wind seems to show that we have to do with a series of local gusts and whirls rather than a single tornado. He says:

The weather chart of 8 a. m., August 2, renders the inference admissible that a secondary depression was formed in the area between Washington, D. C., Lynchburg, Va., Pittsburg, Pa., and Parkersburg, W. Va., and that the winds at each of these stations blew toward the center of this incipient cyclone, which by 3 p. m. had moved eastward to the region of greatest devastation.

The Editor, however, would suggest as equally plausible the following modification of this view. The westerly winds that cross the Alleghany and Blue Ridge blow down over the coastal plain from Virginia to New Jersey in such a way in the afternoon as to underrun and mix with the warmer and moister air that at that time of day overlies the lowlands. When this diurnal phenomenon is intensified by the cooperation of a properly located area of low pressure it invariably leads to the formation of large clouds and often a long series of local storms between 1 p. m. and 9 p. m. along the line of mixtures and ascensions. The atmospheric conditions may be such as to give rise to severe gusts of wind and possibly rain, hail, and lightning. Many such local storms may be in progress simultaneously; they may begin either at the northern or the southern end of the line. Each may move nearly parallel to its neighbors and toward the northeast or the southeast. Each is liable to be so small that we get observations of it from only one or two stations. Occasionally one or two of these storms will have tornadic severity and characteristics, others will be simply ordinary thunderstorms. It would be safer to look for such a series of storms rather than to attempt to explain all the observed phenomena of August 2 as due to one incipient cyclone.

The barometric oscillations during the passage of these storms of August 2 were quite remarkable and have been studied by Mr. H. H. Kimball in an article published in the current number of the WEATHER REVIEW. He confirms Prof. W. M. Davis's idea that the sudden rise of the barometer is largely due not to wind or rain or density of descending air, but to the rapid expansion of moist air in the process of